Remarks

The January 9, 2009 Office Action rejected claim 10 as being of improper dependent form, withdrew certain prior substantive rejections, and formulated new rejections relying on U.S. patent 5,714,166 ("Tomalia et al.) in light of U.S. patent application publication 2002/0102434 ("Inoue et al.), and/or Inoue et al. alone, and/or Inoue et al. in view of a Baldo et al. article. In view of the amendment above and remarks below, reconsideration is respectfully requested.

Dependence Objection

The Office Action correctly noted that claim 10 was dependent on a cancelled claim, claim 7. Applicants note that the PCT form of the claim 10 referred to claim 7 or 8. It was intended that claim 10 be dependent on claim 8, not the cancelled claim 7 as incorrectly indicated in the preliminary amendment. Hence, the above amendment changes the dependency to existing claim 8.

Nature Of The Other Amendments

In claim 1, and thus all claims dependent thereon, the "charge transporting and/or emissive" language has been moved from the preamble of the claim to the body of the claim, thereby clarifying that the property of being charge transporting and/or emissive is a feature of the claimed composition.

Hence, the "charge transporting and/or emissive" language in claim 24 is now duplicative and therefore has been removed from claim 24.

§ 102 Rejections

Claims 1-6 and 8-17 were rejected as anticipated based on Tomalia et al. with further evidence provided by Inoue et al.

As an initial matter, Applicants note that claim 15 has previously been cancelled, and that the Summary Sheet reflects this. Hence, Applicants will construe the anticipation rejection as only applying to claims 1-6, 8-14, 16 and 17.

In any event, the composition defined in amended claim 1 is novel over Tomalia et al. Tomalia et al. does not disclose a composition as defined in amended claim 1 because it does

not disclose a composition which: (a) comprises a combination of *different* dendrimers having (i) the same core and (ii) the same repeating unit in the dendrons, and (b) is charge transporting and/or emissive.

The Examiner refers to column 44, lines 37 to 42 of Tomalia et al. However, this section of Tomalia et al. merely indicates that mixed dendrimers of different generations can be used. For example, it simply states that "combinations of two different sized dendrimers complexed with DNA can enhance transfection". This section of Tomalia et al. certainly does not therefore disclose a composition as defined in amended claim 1 which (a) comprises a combination of different dendrimers having (i) the same core and (ii) the same repeating unit in the dendrons, and (b) which is charge transporting and/or emissive.

The Examiner also references column 104, line 1 to column 105, line 43 (Example 42) of Tomalia et al., referring to compositions P and Q. Compositions P and Q relate to blends of dense star dendrimers. Again, although combinations of different dendrimers are disclosed, there is no clear and unambiguous disclosure of a composition (a) comprising a combination of different dendrimers having (i) the same core *and* (ii) the same repeating unit in the dendrons, *and* (b) which is charge transporting and/or emissive.

In paragraph 9 of the Office Action, the Examiner points out that the core of the dendrimers in compositions P and Q in Tomalia et al. is indicated in parentheses and the generation by the number. However, this nomenclature (e.g. "G6 (NH_3)" and "G5 (NH_3)") gives no indication that the dendrons in these dendrimers have the same repeating units. Example 42 of Tomalia et al. merely indicates that these dendrimers are "dense star dendrimers". Thus, Tomalia et al. is silent regarding the nature of the repeating units in the dendrimers in compositions P and Q. Thus, there is no disclosure in Tomalia et al. that the different dendrimers in compositions P and Q have the same repeating units.

The Office Action also refers to column 30, line 51 onwards of Tomalia et al. and indicates that this teaches a

matching core and repeat unit. There is, however, no such teaching in Tomalia et al. First, column 30, line 51 of Tomalia et al. only discusses the core and branch structure of the dendrimers in general. It represents the dendron core and repeat units as *generalized structures*. Specifically, the repeat units are represented as curly lines between nitrogen atoms, covering may different types of repeat units. There is therefore no teaching at column 30, line 51 onwards of a combination of two different dendrimers having the same core and the same repeat units in the dendrons.

Second, column 30, line 51 onwards of Tomalia et al. does not relate specifically to compositions P and Q in Example 42 of Tomalia et al. Thus, column 30, line 51 onwards of Tomalia et al. does not teach that the different dendrimers in compositions P and Q have the same repeating units. Column 104, line 1 to column 105, line 43 (Example 42) of Tomalia et al. does not therefore disclose a composition containing different dendrimers which have the same core and repeating units, because there is no indication whatever in Tomalia et al. that the different dendrimers in compositions P and Q have the same repeating units.

There is also no indication anywhere in Tomalia et al. that compositions P and Q, described in Example 42 of Tomalia et al., are "charge transporting and/or emissive", as now more directly recited in amended claim 1. Thus, Tomalia et al. does not disclose a combination of different dendrimers having (i) the same core *and* (ii) the same repeating unit, *and* (b) which is charge transporting and/or emissive.

The Office Action further refers to column 16, line 56 to column 17, line 15 and column 19, lines 11 to 28 of Tomalia et al., as suggesting that the dendrimers can include fluorescent and phosphorescent emitting entities. However, when read in context these passages actually disclose that "M", which is a "carried material", can be a signal generator, for example a fluorescing entity, or can contain phosphorescent and fluorescent entities, for example luciferase and alkaline phosphatase. Accordingly, there is no disclosure that the dendrimers themselves would be charge-transporting and/or

emissive.

There is furthermore no disclosure that compositions P and Q in Example 42 of Tomalia et al. contain phosphorescent and fluorescent entities. It cannot therefore be concluded that compositions P and Q in Example 42 of Tomalia et al. are "charge transporting and/or emissive". Tomalia et al. does not disclose a combination of different dendrimers having (i) the same core *and* (ii) the same repeating unit, *and* (b) which is charge transporting and/or emissive.

In sum, the single Tomalia et al. reference clearly fails to anticipate as failing to meet various aspects of the claim language. The Office Action seeks to overcome some deficiencies by asserting Inoue et al. as an evidentiary reference to purportedly clarify that the dendrimers in Tomalia et al. must inherently be conductive.

Firstly, however, Inoue et al. does not disclose the same type of compounds as Tomalia et al. Thus, the Office Action is not directly applying any teaching of Inoue et al. as to what the characteristics of a relevant compound are.

Inoue et al. discloses conjugated compounds which have a central aromatic core group (e.g. a bi-, tri- or tetra-phenylene group) attached to two diphenylamine substituents. The phenyl groups of the diphenylamine substituents are typically substituted with further diarylamine groups. Thus, the compounds of Inoue et al. contain a network of aryl groups connected to each other directly or via nitrogen atoms. The compounds of Inoue et al. are therefore highly conjugated, unsaturated structures; see for instance the compounds exemplified on pages 138 to 140 of Inoue et al.

The compounds exemplified in Tomalia et al. , on the other hand, are polyamidoamine (PAMAM) dendrimers made up of alkyl amides. In these compounds, saturated alkylene groups are linked together in a dendritic structure by bidentate amide groups and tridentate nitrogen atoms (see the PAMAM dendrimers exemplified in columns 60 to 62 of Tomalia et al.). The dendrimers exemplified in Tomalia et al. therefore contain saturated alkyl linker groups without any double bonds.

The compounds of Tomalia et al. are therefore made up of

saturated alkyl regions and are not conjugated like the compounds of Inoue et al. They have a very different chemical structure from the compounds of Inoue et al. Since the chemical structures of the compounds of Inoue et al. (conjugated aryl-containing compounds) are very different from those of Tomalia et al. (non-conjugated alkyl amide dendrimers), Inoue et al. cannot be considered to provide any credible evidence regarding what the properties of the compounds disclosed in Tomalia et al. must be as required for an inherency finding.

Furthermore, Inoue et al. certainly does not provide any evidence to suggest that the compounds disclosed in Tomalia et al. are inherently conductive, as the Examiner has suggested. As explained above, the alkyl amides disclosed in Tomalia et al. comprise saturated regions and are not conjugated; the skilled person would therefore expect such compounds not to be electrically conductive. In contrast, aryl amines such as those in Inoue et al. are conjugated systems that can be electrically conductive.

The skilled person would not therefore inherently know that the dendrimers exemplified in Tomalia et al. are electrically conductive because such PAMAM dendrimers are made up of saturated, non-conjugated alkyl regions. Furthermore, PAMAM dendrimers are known to be electrical insulators. This is evidenced by Luo et al., Journal of Applied Polymer Science, Vol. 89, 1515-1519 (2003) ("Luo et al."), filed herewith in a separate Supplemental Information Disclosure Statement. Luo et al. compares the conductivities of layers of PAMAM dendrimers with and without silver nanoparticles, and the PAMAM film without silver nanoparticles was found to be an electrical insulator. This is taught on page 1518 of Luo et al., right hand column, which states:

> As shown in Figure 6, the impedance of a 50-bilayer film of Ag-PAMAM/DR coated on a copper electrode was 720 ohm (conductivity was between 10^{-3} and 10^{-4} S/cm). In contrast, a PAMAM-DR multilayer film, which did not contain Ag nanoparticles, was almost an isolator. [emphasis added]

The Office Action has not therefore provided any evidence

to support the assertion that the dendrimers described in Tomalia et al. are inherently conductive. Inoue et al. certainly does not constitute such evidence. In fact, the compounds described in Tomalia et al. would, given the teachings of Inoue et al., be expected not to be conductive due to the general lack of conjugation, but to be electrical insulators instead.

The subject matter of claim 1 is not therefore anticipated by Tomalia et al. Tomalia et al. does not disclose a combination of different dendrimers which is charge transporting and/or emissive, let alone a combination of different dendrimers having (i) the same core *and* (ii) the same repeating unit, *and* (b) which is charge transporting and/or emissive.

Regardless, in an earnest attempt to try to resolve the Examiner's concerns regarding this art, Applicants' representative noted the comment in paragraph 9 that the light emitting and conductivity wording in claim 1 was only in the preamble (not the body) of claim 1, and as such was not entitled to substantial patentable weight. Thus, this wording has now been recited in the body of claim 1. This should permit greater significance to be given to this limitation.

§ 103 Rejections

A. The present inventors have surprisingly found that the use of a mixture of dendrimers having the same core and the same repeating unit, but different generations of dendrons and/or different numbers of dendrons, leads to unexpected improvements in the efficiency of opto-electronic devices. These unexpected advantages of the claimed compositions are evidenced by the attached declaration by a co-inventor, Professor Paul L. Burn.

It is noted that the copy of the declaration submitted herewith is unsigned, but has been reviewed by inventor Burn. Due to the need to submit a response no later than today, it is being submitted in its present form. A signed copy of this declaration will follow shortly.

The comparative data attached to that declaration as Exhibit 2 show that the compositions of the invention provide

major efficiency advantages compared with prior art compositions. As is stated in the declaration, there are clear and significant improvements in efficiency when compositions of the invention are used compared with prior art compositions. The present invention therefore solves the problem of providing organic light emitting devices with improved efficiency and, potentially, lifetime. These results could not have been predicted in view of the prior art; they were therefore surprising and unexpected results. Hence, regardless of specific distinctions, any assertion of obviousness is believed overcome by the declaration.

B. Turning now to consider the first obviousness rejection, claims 1, 3-6, 11, 12, 13, 14 and 16 were rejected as obvious in view of Inoue et al. alone. Of course, the Office Action acknowledges that Inoue et al. does not use a plurality of compounds of formula (I) in combination. However, there are also other differences.

There is furthermore no teaching or suggestion in Inoue et al. that a mixture of dendrimers having the same core and the same repeating unit but different generations of dendrons and/or different numbers of dendrons could be used, much less that the use of such a mixture of dendrimers in a device would provide the major efficiency advantages evidenced by the attached declaration.

Although paragraph [0148] of Inoue et al. does mention using more than one compound in combination, this is certainly not the same as teaching the use of two or more dendrimers in combination wherein the dendrimers (a) have the same core and (b) the same repeating unit and (c) different generations of dendrons or different numbers of dendrons. Indeed, paragraph [0148] of Inoue et al. makes no suggestion that the compounds to be combined should have a close structural association, much less that they should have the same core and repeating unit but different generations of dendrons and/or different numbers of dendrons.

The Examiner will note that the definitions of R_1 to R_4 in the tables of Inoue et al. and the definitions of R_{01}, R_{02}, R_{03} and R_{04} in formula (I) in Inoue et al. cover many different

branching dendron groups. Similarly, the definition of L_0 in formula (I) in Inoue et al. allows for several different core types. Thus, a very wide variety of compounds are covered by the definitions in Inoue et al.

Paragraph [0148] of Inoue et al., on the other hand, merely mentions the use of "two or more" such compounds in combination. It is clear that "two or more" such compounds as stated in paragraph [0148] covers a huge number of combinations of two compounds. These include combinations of two compounds with different core groups, combinations of two compounds with different dendron repeat units, and combinations of two compounds with the same generation and number of dendrons, but none of these combinations falls within the present claims. There is therefore no teaching whatever in Inoue et al. to select two or more dendrimers which (a) have the same core and (b) the same repeating unit in the dendrons and (c) different generations of dendrons or different numbers of dendrons. Neither paragraph [0148], nor any other section of Inoue et al., even remotely suggests making such a combination of two or more compounds as defined in the present claims.

Furthermore, Inoue et al. certainly does not teach or suggest that such a combination would provide the surprising efficiency advantages observed by the present inventors.

There is therefore no suggestion in Inoue et al. of the claimed composition of dendrimers wherein the dendrimers (a) have the same core and (b) the same repeating unit but (c) different generations of dendrons or different numbers of dendrons. Furthermore, Inoue et al. does not provide any motivation to arrive at such a combination of dendrimers because it does not suggest that such a combination would provide the surprising efficiency advantages observed by the present inventors. The subject matter defined in claim 1, or in any of dependent claims 3-6, 11, 12, 13, 14 and 16, would not therefore have been obvious in view of Inoue et al.; reconsideration of the rejection is therefore respectfully requested.

C. With respect to the second obviousness rejection,

claims 2, 8-10, 24, 26-28 and 35-39 were rejected as being obvious in view of Inoue et al., and further in view of Baldo et al. As stated above, Inoue et al. doesn't suggest the claimed composition of dendrimers wherein the dendrimers (a) have the same core and (b) the same repeating unit yet (c) different generations of dendrons or different numbers of dendrons. Furthermore, Inoue et al. does not provide any motivation or other suggestion to arrive at such a combination of dendrimers because it does not suggest that such a combination would provide the surprising efficiency advantages observed by the present inventors (see the attached declaration by Paul L. Burn).

Baldo et al. also does not suggest the claimed composition of dendrimers, let alone that such a composition would provide the surprising efficiency advantages evidenced by the attached declaration. Baldo et al. does not therefore remedy the deficiencies of Inoue et al. or hint at the advantages of the present invention, including the improved device efficiencies observed. Rather, Baldo et al. is an academic study of triplet energy transfer in systems where a phosphorescent guest is dispersed in a host material. The skilled person would not therefore have consulted Baldo et al. for a relevant teaching, and in any event even if this reference were looked to it could not have lead the skilled person to the claimed subject matter.

The Office Action nonetheless suggests that it would have been obvious to expect the higher generation dendrimers of Inoue et al. to exhibit similar fluorescent and phosphorescent properties of the generation 1 dendrimer, TPD, due to the structural similarity between the compounds. The Office Action then suggests that it would have been obvious to use the dendrimers as host materials in the light emitting layer as taught by Baldo et al. with the expectation that the materials would provide light emission and high hole mobility.

In response, it is again noted that one of ordinary skill in the art would not have thought to combine these references. Baldo et al. relates to the specific instance of guest-host systems, and would not be seen as directly compatible with the

teaching of Inoue et al. Furthermore, the Baldo et al. reference is not relevant to the current claims because the guest-host systems described therein include (i) fluorescent hosts, and (ii) guests which are emissive due to the energy transfer. In other words, the emissive and charge transport properties of the two materials are very different. In contrast, the claimed blend of dendrimers of the present invention is the charge transporting and/or emissive component: there is no requirement for a guest-host system.

Furthermore, even if one of ordinary skill in the art did have knowledge of both Inoue et al. and Baldo et al., there would be no motivation to make mixtures of dendrimers with (1) the same core, and (2) the same repeating unit, but where the number of dendrons and/or the generation of the dendrons differs. As mentioned earlier, neither document even remotely suggests such a combination of dendrimers, let alone teaches that such a combination would provide desirable properties.

In addition, it should be noted that according to Baldo et al., the material TPD is only phosphorescent at -263ºC, which is clearly an impractical operating temperature. In comparison the claimed blends of dendrimers operate in a much more practical temperature range. If the Office Action's reasoning is followed, the skilled person would expect the higher generation compounds of Inoue et al. to have similar fluorescent and phosphorescent properties as TPD. The skilled person would therefore conclude that the higher generation compounds of Inoue et al. would only be phosphorescent at very low temperatures (around -260ºC). This would clearly be inappropriate for most technical applications. As such, the skilled person would not be led to combine the teaching of Baldo et al. and Inoue et al.

Furthermore, the Office Action's comment that the Inoue et al. materials would obviously have similar emitting properties to TPD is incorrect. The pyrene derivative on page 50 of Inoue et al. would have very different emissive properties to TPD and may in fact quench the luminescence of the $Ir(ppy)_3$ complex described in Baldo et al. This is supported by Zhao et al., J. Phys. Chem. A 2006, 110, 11440-

11445 ("Zhao et al."), and Xin et al., Phys. Chem. Chem. Phys., 2002, 4, 5895-5898 ("Xin et al."), filed herewith in the Supplemental Information Disclosure Statement.

Fig. 2 of Zhao et al. shows the photoluminescence spectrum of pyrene as a dotted line. This is completely different from the emission spectrum of TPD, which is shown as a dotted line in Fig. 2(a) of Xin et al. As can be seen by comparing the spectra of the two compounds (Fig. 2 of Zhao et al. and Fig. 2(a) of Xin et al.), their spectra have different shapes and different lambda max values. It is therefore clear that pyrene and TPD have completely different emissive properties. The evidence therefore supports that the Inoue et al. materials would not have similar emitting properties to TPD.

Furthermore, the evidence supports that the Inoue et al. materials would quench the luminescence of the $Ir(ppy)_3$ complex described in Baldo et al.. This is supported by the last paragraph in the right hand column of page 11442 of Zhao et al., which clearly states:

> The MCLT-based photoluminescence in $Ir(ppy)_3$ is efficiently quenched by both pyrene and *tert*-butylpyrene

Thus it is clear that the Inoue et al. materials, such as pyrene-containing materials, do not have similar emitting properties to the TPD compound described in Baldo et al., and that the Inoue et al. materials would be expected to quench the luminescence of the $Ir(ppy)_3$ complex described in Baldo et al.

The Office Action's comment that the Inoue et al. materials would obviously have similar emitting properties to TPD is not correct and is certainly not supported by the evidence.

In view of the arguments above, one of ordinary skill in the art would not consider combining the teaching of Inoue et al. and Baldo et al. when seeking to provide new and inventive dendrimer compositions for light emitting devices. Even if the teachings of these documents were to be combined, it would not be obvious how this should be achieved because the teachings are at least in part incompatible (e.g. Baldo et al.

relates to a guest-host system, which is different from the system in Inoue et al.).

Furthermore, the combination of the two documents would certainly not lead to the blends claimed in claim 1 of the present invention. Indeed, neither document even remotely suggests a combination of dendrimers with (1) the same core, and (2) the same repeating unit, but (3) where the number of dendrons and/or the generation of the dendrons differs, let alone teaches that such a combination would provide the unexpected and desirable properties as evidenced by the attached declaration by Paul L. Burn.

In addition, the properties of the components used in the Baldo et al. and Inoue et al. systems would not be expected to be the same. Accordingly, this would suggest to the skilled person that a combination of the materials of these documents would not be advantageous. In fact, if the pyrene compounds of Inoue et al. were combined with the $Ir(ppy)_3$ complex of Baldo et al., this would in fact have an adverse effect on electroluminescent properties (see the last paragraph in the right hand column of page 11442 of Zhao et al.). For these reasons, it would not be obvious to combine Inoue et al. and Baldo et al., and we therefore submit that the subject matter of the claims currently on file is non-obvious over these documents.

D. Having demonstrated that the subject matter of claim 1 is non-obvious over the cited documents, it is respectfully submitted that the remaining claims, all of which depend from or refer back to claim 1, are also non-obvious.

Conclusion

As such, reconsideration and allowance are respectfully requested of the remaining amended claims. Submitted herewith are a three month extension of time, together with an RCE request, a declaration, and a Supplemental IDS. These permit the above issues to be considered without the procedural restrictions of after final practice.

Apart from the three month extension fee and the RCE fee, no additional fees are believed necessary for the entry of this amendment. However, if any are, please charge Deposit

Account 17-0055 for the amount of the fee.

Respectfully submitted,

PAUL L. BURN ET AL.

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